

REVISION OF SECTION 702  
BITUMINOUS MATERIALS

Section 702 of the Standard Specifications is hereby deleted for this project and replaced with the following:

**702.01 Asphalt Cements.**

- (a) *Superpave Performance Graded Binders.* Superpave Performance Graded Binders shall conform to the requirements listed in Table 702-1. (Taken from AASHTO M 320)

Asphalt cement shall not be acid modified or alkaline modified.

Asphalt cement shall not contain any used oils that have not been rerefined. Modifiers that do not comply with environmental rules and regulations including 40 CFR Part 261.6(a) (3) (IV), and part 266/Subpart C shall not be added. Modifiers shall not be carcinogenic.

The supplier of the PG binder shall be certified in accordance with CP 11.

REVISION OF SECTION 702  
BITUMINOUS MATERIALS

**Table 702-1**  
**SUPERPAVE PERFORMANCE GRADED BINDERS**

Property	Requirement for PG Binder					AASHTO Test No.
	58-28	58-34	64-22	64-28	76-28	
<b>Original Binder Properties</b>						
Flash Point Temp., °C, minimum	230	230	230	230	230	T 48
Viscosity at 135 °C, Pa•s, maximum	3	3	3	3	3	T 316
Dynamic Shear, Temp. °C, where $G^*/\sin \delta @ 10 \text{ rad/s} \geq 1.00 \text{ kPa}$	58	58	64	64	76	T 315
Ductility, 4 °C (5 cm/min.), cm minimum	-	-	-	50	-	T 51
Toughness, joules (inch-lbs)	-	-	-	12.4 (110)	-	CP-L 2210
Tenacity, joules (inch-lbs)	-	-	-	8.5 (75)	-	CP-L 2210
Acid or Alkali Modification (pass-fail)	Pass	Pass	Pass	Pass	Pass	CP-L 2214
<b>RTFO Residue Properties</b>						
Mass Loss, percent maximum	1.00	1.00	1.00	1.00	1.00	CP-L 2215
Dynamic Shear, Temp. °C, where $G^*/\sin \delta @ 10 \text{ rad/s} \geq 2.20 \text{ kPa}$	58	58	64	64	76	T 315
Elastic Recovery, 25 °C, percent min.	-	-	-	-	50	T 301
Ductility, 4 °C (5 cm/min.), cm minimum	-	-	-	20	-	T 51
<b>PAV Residue Properties, Aging Temperature 100 °C</b>						
Dynamic Shear, Temp. °C, where $G^* \cdot \sin \delta @ 10 \text{ rad/s} \leq 5000 \text{ kPa}$	19	16	25	22	28	T 315
Creep Stiffness, @ 60 s, Test Temperature in °C	-18	-24	-12	-18	-18	T 315
S, maximum, MPa	300	300	300	300	300	T 313
m-value, minimum	0.300	0.300	0.300	0.300	0.300	T 313
**Direct Tension, Temperature in °C, @ 1 mm/min., where failure strain $\geq 1.0 \%$	-18	-24	-12	-18	-18	T 314
**Direct tension measurements are required when needed to show conformance to AASHTO M 320.						

REVISION OF SECTION 702  
BITUMINOUS MATERIALS

Acceptance Samples of the PG binder will be taken on the project in accordance with the Schedule in the Field Materials Manual.

The Department will test for acid modification and alkaline modification during the binder certification process. Thereafter, the Department will randomly test for acid modification and alkaline modification.

- (b) *Dampproofing.* Asphalt for damp proofing shall conform to the requirements of ASTM D 449, and the asphaltic primer shall conform to the requirements of ASTM D 41.

**702.02 Liquid Asphaltic Materials.** Liquid asphaltic materials shall conform to the requirements of AASHTO M 81, M 82, and ASTM D 2026 for the designated types and grades.

**702.03 Emulsified Asphalts.** Emulsified asphalts shall conform to AASHTO M 140 or M 208 for the designated types and grades. Emulsified asphalt and aggregate used for seal coats shall be sampled and will be tested for information only in accordance with CP-L 2213.

When grade CSS-1h or SS-1h emulsified asphalt is used for tack coat, residue penetration test values shall be 40 to 120.

Emulsified asphalt (HFMS-2S) with a residual penetration greater than 300 dmm shall conform to all properties listed in AASHTO M 140, Table 1 except that ductility shall be reported for information only.

- (a) *Emulsion for Seal Coat.* Polymerized emulsions for seal coat shall conform to the requirements listed in Table 702-2. Emulsion for seal coat shall be an emulsified blend of polymerized asphalt, water, and emulsifiers. The asphalt cement shall be polymerized prior to emulsification and shall contain at least 3 percent polymer by weight of asphalt cement. The emulsion standing undisturbed for a minimum of 24 hours shall show no white, milky separation but shall be smooth and homogeneous throughout. The emulsion shall be pumpable and suitable for application through a distributor.

REVISION OF SECTION 702  
BITUMINOUS MATERIALS

**Table 702-2**  
**POLYMERIZED EMULSIONS FOR SEAL COATS**

Property		CRS-2P	CMS-2P	HFRS-2P	HFMS-2P	AASHTO Test No.
<b>Tests on Emulsion:</b>						
Viscosity, at 50 °C, Saybolt-Furol, s	<b>min</b>	50	50	50	50	T 59
	<b>max</b>	450	450	450	450	
Storage stability, 24 hr, % max		1.0	1.0	1.0	1.0	T 59
Particle charge test		Positive	Positive			T 59
Sieve test, % max		0.10	0.10	0.10	0.10	T 59
Demulsibility <sup>1</sup> , % min		40		40		T 59
Oil Distillate by volume, % max or range		3.0	3.0	3.0	3.0	T-59
Residue by distillation/ evaporation, % min <sup>3</sup>		65 <sup>3</sup>	65 <sup>3</sup>	65 <sup>3</sup>	65 <sup>3</sup>	T 59/ CP-L 2212 <sup>2</sup>
<b>Tests on residue:</b>						
Penetration, 25 °C, 100g, 5s, min, dmm		70	70	70	70	T 49
Penetration, 25 °C, 100g, 5s, max, dmm		150	150	150	150	
Ductility, 25 °C, 5 cm/min, cm, min				75	75	T 51
Solubility, in trichloroethylene% min		97.5	97.5	97.5	97.5	T 44
Elastic Recovery, 25 °C min				58	58	T 301
Float Test, 60 °C, s min				1200	1200	T 50
Toughness, in-lbs, min		70	70			CP-L 2210
Tenacity, in-lbs, min		45	45			CP-L 2210

<sup>1</sup>If successful application is achieved in the field, the Engineer may wave this requirement.

<sup>2</sup> CP-L 2212 is a rapid evaporation test for determining percent residue of an emulsion and providing material for tests on residue. CP-L 2212 is for acceptance only. If the percent residue or any test on the residue fails to meet specifications, the tests will be repeated using the distillation test in conformance with AASHTO T-59 to determine acceptability.

<sup>3</sup> For polymerized emulsions the distillation and evaporation tests will in be in conformance with AASHTO T-59 or CP-L 2212 respectively with modifications to include 205 ± 5 °C (400 ± 10 °F) maximum temperature to be held for 15 minutes.

5  
REVISION OF SECTION 702  
BITUMINOUS MATERIALS

- (b) *Emulsion for Prime Coat.* Emulsion for prime coat shall conform to the requirements of Table 702-3. Circulate before use if not used within 24 hours.

**Table 702-3**  
**ASPHALT EMULSION FOR PRIME COAT**

Property	Requirement	AASHTO Test No.
Viscosity, Saybolt Furol, at 50 °C (122 °F), s	20-150	T 59
% Residue	65% min.	T 59 to 260 °C (500 °F)
Oil Distillate by Volume, %	7% max.	T59
<b>Tests on Residue from Distillation:</b>		
Solubility in Trichloroethylene, %	97.5 min.	T 44

- (c) *Recycling Agent.* Recycling Agent for Item 406, Cold Bituminous Pavement (Recycle), shall be either a high float emulsified asphalt (polymerized) or an emulsified recycling agent as follows:
1. High Float Emulsified Asphalt (Polymerized). High Float Emulsified Asphalt (Polymerized) for Cold Bituminous Pavement (Recycle) shall be an emulsified blend of polymer modified asphalt, water, and emulsifiers conforming to Table 702-4 for HFMS-2sP. The asphalt cement shall be polymerized prior to emulsification, and shall contain at least 3 percent polymer.

The emulsion standing undisturbed for a minimum of 24 hours shall show no white, milky separation, and shall be smooth and homogeneous throughout.

The emulsion shall be pumpable and suitable for application through a pressure distributor.

6  
 REVISION OF SECTION 702  
 BITUMINOUS MATERIALS

**Table 702-4**  
**HIGH FLOAT EMULSIFIED ASPHALT**  
**(POLYMERIZED) (HFMS-2sP)**

Property	Requirement		AASHTO Test
	Minimum	Maximum	
<b>Tests on Emulsion:</b>			
Viscosity, Saybolt Furol at 50 °C (122 °F), sec	50	450	T 59
Storage Stability test, 24 hours, %		1	T 59
Sieve test, %		0.10	T 59
% Residue <sup>1</sup>	65		T 59
Oil distillate by volume, %	1	7	T 59
<b>Tests on Residue:</b>			
Penetration, 25 °C (77 °F), 100g, 5 sec	150	300 <sup>2</sup>	T 49
Float Test, 60 °C (140 °F), sec	1200		T 50
Solubility in TCE, %	97.5		T 44
Elastic Recovery, 4 °C (39.2 °F), %	50		T 301
<sup>1</sup> 400 ± 10 °F maximum temperature to be held for 15 minutes. <sup>2</sup> When approved by the Engineer, Emulsified Asphalt (HFMS-2sP) with a residual penetration greater than 300 dmm may be used with Cold Bituminous Pavement (Recycle) to address problems with cool weather or extremely aged existing pavement. Emulsified Asphalt (HFMS-2sP) with a residual penetration greater than 300 dmm shall meet all properties listed in Table 702-4 except that Elastic Recovery shall be reported for information only.			

2. *Emulsified Recycling Agent.* Emulsified Recycling Agent for use in Cold Bituminous Pavement (Recycle) shall conform to the requirements in Table 702-5.

7  
 REVISION OF SECTION 702  
 BITUMINOUS MATERIALS

**Table 702-5**  
**EMULSIFIED RECYCLING AGENT**

Property	Requirement		Test
	Minimum	Maximum	
<b>Tests on Emulsion:</b>			
Viscosity @ 25 °C, SFS	20	200	ASTM D 244
Pumping Stability	Pass		GB Method <sup>1</sup>
			ASTM D 244 <sup>2</sup>
Sieve Test, %w		0.1	
Cement Mixing, %w		2.0	ASTM D 244
Particle Charge	Positive		ASTM D 244
Conc. Of Oil Phase	64		ASTM D 244 <sup>3</sup>
<b>Tests on Residue:</b>			
Viscosity @ 60 °C , CST	2000	4000	ASTM D 2170
Flash Point, COC, °C (°F)	232		ASTM D 92
Maltenes Dist. Ratio <sup>4</sup> $\frac{PC+A_1}{S+A_2}$	0.3	0.6	ASTM D 2006
PC/S Ratio	0.4		ASTM D 2006
Asphaltenes, % max.		11.0	ASTM D 2006
<p><sup>1</sup>Pumping stability is determined by charging 450 ml of emulsion into a one liter beaker and circulating the emulsion through a gear pump (Roper 29.B22621) having a 6.3 mm (1/4 inch) inlet and outlet. The emulsion passes if there is no significant separation after circulating ten minutes.</p> <p><sup>2</sup>Test procedure identical with ASTM D 244 except that distilled water shall be used in place of 2 percent sodium oleate solution.</p> <p><sup>3</sup>ASTM D 244 Evaporation Test for percent of residue is modified by heating 50 gram sample to 149°C (300 °F) until foaming ceases, then cooling immediately and calculating results.</p> <p><sup>4</sup>In the Maltenes Distribution Ratio Test by ASTM Method D 2006.</p> <p style="text-align: center;">PC = Polar Compounds S = Saturates  A<sub>1</sub> = First Acidaffin A<sub>2</sub> = Second Acidaffins</p>			

8  
REVISION OF SECTION 702  
BITUMINOUS MATERIALS

**702.04 Asphalt Rejuvenating Agents.** Asphalt rejuvenating agents (ARA) shall be composed of a petroleum resin-oil base uniformly emulsified with water and shall conform to the physical and chemical requirements of Table 702-6 or ASTM D 4552.

**Table 702-6  
ASPHALT REJUVENATING AGENT**

Property	Test Method	Requirement
Viscosity, S.F., @ 25 °C (77 °F), s	ASTM D 244	20-40
<sup>1</sup> Residue, % min.	ASTM D 244	60-65
<sup>2</sup> Miscibility Test	ASTM D 244	No coagulation
<sup>3</sup> Sieve Test, % max.	ASTM D 244	0.10
Particle Charge Test	ASTM D 244	Positive
<b>ASTM D244 (Mod):</b>		
Viscosity, 60 °C (140 °F), mm <sup>2</sup> /s	ASTM D 445	100 - 200
Flash Point, COC, °C, min.	ASTM D 92	196
Asphaltenes, % max.	ASTM D2006	1.0
<sup>4</sup> Maltenes Dist. Ratio $\frac{PC+A_1}{S+A_2}$	ASTM D 2006	0.3-0.6
Saturated Hydrocarbons, %	ASTM D 2006	21-28
<p><sup>1</sup> ASTM D244 Modified Evaporation Test for percent of residue is made by heating 50-gram sample to 149 °C (300 °F) until foaming ceases, then cooling immediately and calculating results.</p> <p><sup>2</sup> Test procedure identical with ASTM D244 except that 0.02 Normal Calcium Chloride solution shall be used in place of distilled water.</p> <p><sup>3</sup> Test procedure identical with ASTM D244 except that distilled water shall be used in place of 2% sodium oleate solution.</p> <p><sup>4</sup> In the Maltenes Distribution Ratio Test by ASTM Method D4124:</p> <p style="text-align: center;">PC = Polar Compounds    S = Saturates A<sub>1</sub> = First Acidaffin    A<sub>2</sub> = Second Acidaffins</p>		

For hot-in-place recycling ARA-1P is an acceptable alternative to ARA. ARA-1P shall meet the requirements below:

Emulsified Polymer Modified Asphalt Rejuvenating Agent (ARA-1P) for use in hot-in-place recycling of bituminous pavements shall be modified with a minimum of 1.5 percent styrene-butadiene solution polymer. The finished product shall conform to the physical requirements listed in Table 702-7 below.

9  
REVISION OF SECTION 702  
BITUMINOUS MATERIALS

**Table 702-7**  
**ARA-1P**

Property	Test Method	Min	Max
<b>Test on Emulsion</b>			
Viscosity, Saybolt-Furol @ 77 °F, s	ASTM D 244		100
Residue @ 350 °F, %	ASTM D 244 Mod	60	
Sieve Test, %	ASTM D 244		0.10
Oil distillate, %	ASTM D 244		2.0
<b>Test on Residue</b>			
Penetration @ 39.2 °F, 100g, 5s, dmm	ASTM D-5 Modified	150	250
Asphaltenes, %	ASTM D 4124		15

**702.05 (unused)**

**702.06 Hot Poured Joint and Crack Sealant.** Hot poured material for filling joints and cracks shall conform to the requirements of ASTM D 6690, Type I or II. The concrete blocks used in the Bond Test shall be prepared in accordance with CP-L 4101.

Sealant material shall be supplied preblended, prereacted, and prepackaged. If supplied in solid form the sealant material shall be cast in a plastic or other dissolvable liner having the capability of becoming part of the crack sealing liquid. The sealant shall be delivered in the manufacturer's original sealed container.

Each container shall be legibly marked with the manufacturer's name, the trade name of the sealer, the manufacturer's batch or lot number, the application temperature range, the recommended application temperature, and the safe heating temperature.

The sealant shall be listed in CDOT's Approved Products List prior to use.

10  
 REVISION OF SECTION 702  
 BITUMINOUS MATERIALS

**Colorado Procedure – Laboratory CP-L 4101**

**Standard Practice for**

**Preparing Concrete Blocks for Testing Sealants,  
 for Joints and Cracks**

ASTM Designation: D 1985-03

**NOTE:** Replace Subsections 5.1, 5.1.1, and 5.2 of ASTM D 1985-03 with the following:

- 5.1 Prepare the concrete in accordance with the procedure described in Test Method C 192/C102M using the following mix design:

Concrete Mix Proportions for 1 Cubic Yard  
 SSD Batch Weight

Cement, Type I/II	528 lb
Flyash, Class F	132 lb
Coarse Aggregate, Morrison Quarry, #57/67	1750 lb
Sand, Thornton Pit, Washed Sand	1100 lb

Note: Contact Aggregate Industries at 303.777.2592 to obtain the aggregates.

- 5.2. Use a metal or plastic mold provided with a metal or plastic base plate. Provide means for securing the base plate to the mold. Make the assembled mold and base plate water-tight and

oil with mineral oil before use. Fill the mold with concrete prepared in accordance with 5.1 to overflowing and vibrate externally for 30 s. Screed (level) the concrete to a smooth surface with a wooden float and level off with a metal straightedge drawn across the top with a sawing motion. Cure as specified in Test Method C 192/C 192M. After curing for not less than 14 days, cut the slab of concrete into individual blocks using a 40 by 60-grit diamond saw blade rotating at a peripheral speed of  $3050 \pm 150$  m/min. ( $10\ 000 \pm 500$  ft/min.). Each test block should be 25 by 50 by 75 mm (1 by 2 by 3-in.). Any face contacting the test material must be saw cut. While the blocks are still wet from the sawing operation, scrub the surfaces of the blocks lightly with a non-metallic stiff-bristle brush while holding under a stream of running water. Stocks of prepared blocks may be stored under standard conditions indefinitely, but store such blocks in a 100% humidity environment for not less than 7 days prior to use.